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adapted for their purpose. Use strengthens organs, disuse enfeebles them, and even new organs, or at least differentiations of old ones, or a modification of their function may be acquired. Lamarck is the most famous advocate of the idea that such acquired characters tend to be transmitted. The idea is evidently prevalent that the children of one who has exercised his musical talent are furnished congenitally with increased musical abilities.

We must seek in the protoplasm of the egg (or *germ cell*) for structures that bear the impress of powers that represent the whole body. This is the modern form of the old doctrine of evolution which saw in the germ cell a complete miniature of the adult. But we must add that this structure of protoplasm can vary either spontaneously or in response to stimuli definitely or indefinitely.

*Perigenesis der Plastidule.* HÆCKEL.

Hæckel conceives protoplasm to be ultimately composed of molecular units that are themselves a complex system of vibrating atoms. Every new stimulus modifies and complicates the system. When a cell divides into equal parts the form of vibration of the molecules of the two cells is alike, but now the two cells are no longer acted on by similar forces and their systems become more and more divergently modified through life. Thus may we explain variation and phylogenetic differentiation. When cells divide into differentiated cells of the tissues in ontogeny, there is a splitting of the wave movements into two simpler systems. The increase of protoplasm by assimilation is the impressing upon the food molecules of an identical form of vibration. Finally, in sexual reproduction, which is simply the union of two germ cells from different parents, usually not too closely nor too distantly related, there is a union of systems that differ slightly, and hence a new combination, a new variety; so that in sexual reproduction the offspring never are the complete copies of their parents. It is evident that the weak point in this theory is that we have not the faintest idea how the wave motion is caused to split up in ontogeny according to so definite laws, nor, what is more important, how the conditions of the environment cause the proper variations to take place, that adapt the body to the environment. Then, too, we know that *the environment is of importance in ontogeny for not all the characters of protoplasm are ever brought out in any case*. The same person, if he could be brought back to repeat his life history under different circumstances, would appear as a very different individual in the final outcome. Life is full of "latent characters" waiting the proper stimulus to become active. Yet how does this action of the environment differ from the action which causes variation and new hereditary possession? Here is the field for inquiry.

Hæckel attempts to lay the foundations of Psychology by calling the persistence of these vibration-systems in their respective forms *memory*. Ontogenetic development is a rehearsing of the experience of protoplasm when it was in the ancestors, (for every child is but a portion of his parent, so that all protoplasm that is alive dates back to the foundation of the world). All that has been experienced has been retained in this cell memory.

Hæckel goes deeper than any other speculator upon these problems, and in some respects his theory has the merit of simplicity.

*Abstammungslehre.* NÄGELI.

Nägeli derides the Perigenesis theory and substitutes the "Idioplasm" theory. Not all protoplasm carries the hereditary powers, but that which does may be termed Idioplasm. This plasm is supposed to be distributed throughout the cell in the form of fibres that reach to the periphery of the cell; and whenever cells divide and remain united, the

fibres of neighboring cells are continuous; as, indeed, recent studies in the continuity of protoplasm seem to show. The entire idioplasm of the body is then one immense *reticulum*, and a higher organism is thus related to the outside world as a cell on a larger scale. Any disturbance of the idioplasm at one point is transmitted to distant points. Thus the idioplasm preserves a uniform structure so that all cross sections are similar. But the fibre itself is supposed to be composed of rows of units termed *micellae*. The micellae are alike in a single row, and grow and reproduce in a longitudinal direction only. But different rows are unlike; and the peculiar characteristics of an organism depend on the particular structure which a cross section represents. Furthermore, not all the micellae of the cross section are active at once, but certain layers of them act, and in turn stimulate more internal or external layers to activity, and in this way the orderly succession of the cyclic development of ontogeny may be accounted for. All this has been upset by recent discoveries concerning the cell nucleus. In sexual reproduction the characters of the father appear equally transmitted with those of the mother. These characters are therefore contained in the spermatozoon.

*Beiträge zur Kenntniss der Bildung, Befruchtung und Theilung des thierischen Eies.* O. HERTWIG. Leipzig, 1876.

Hertwig has shown that the union of sperm cell and egg cell known as fertilization or fecundation, consists essentially in the fusion of two similar nuclei (male and female pronuclei), sometimes the tail of the spermatozoon not even entering the egg. Studies of the production of the spermatozoon (*spermatogenesis*) show that cells (quite similar to those that in the female reproductive organs become ova by growth) in the male reproductive organs after repeated divisions become spermatozoa by direct transformation of the cell protoplasm to serve locomotive purposes, the nucleus remaining in the "head" of the spermatozoon. Kölliker, however, derives the entire body of the spermatozoon from the nucleus. It is certain that a large part of the cell protoplasm is lost, and only that immediately surrounding the nucleus is utilized in the maturation of the male element in the highest animals.

*Neue Untersuchungen über den Befruchtungsvorgang bei den Phanerogamen als Grundlage für eine Theorie der Zeugung.* STRASBURGER. Jena, 1884.

This observer has shown that in the tube of the pollen grain, when it has sprouted upon the stigma of a flower, a nucleus ("generative nucleus") wanders down and seeks the nucleus of the germ cell of the ovary.

Gruber, and others in studying the sexual unions of the unicellular animals, have shown that there is a dividing up of the nucleus, and in reciprocal fertilization (*conjugation*, or copulation of *ciliata*), there is a mutual interchange of nuclear material; while in zygotic fertilization (similar to the union of ovum and spermatozoon) there is a union of the nuclei to form one nucleus.

*Bericht der Naturforschenden Gesellschaft zu Freiburg.* Vol. 1, 1886. GRUBER.

Gruber has found that by cutting up stentors, the fragments became regenerated to complete stentors whenever a portion of the nucleus was retained in the segment cut off. This experiment proved definitely that the power of assimilation rests with the nucleus, or at least the nucleus has a necessary control. We may also conclude that the nucleus is not a definite structure like the idioplasm of Nägeli, but is an aggregation of gemmules that are alike; each of which can reproduce itself *ad lib-*